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NORTH VANCOUVER
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1990 ANNUAL REPORT

LEADED AND LEAD-FREE GASOLINE REGULATIONS MONITORING PROGRAM

Regional Program Report - 91-02

By

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ABSTRACT

This report describes the gasoline monitoring program conducted in British Columbia during 1990. Samples of leaded and lead-free gasoline were collected and analyzed to check the lead content and verify compliance with the Leaded and Lead-Free Gasoline Regulations.

A survey was also conducted to investigate the practice of nozzle switching on leaded gasoline dispensing pumps at retail outlets.

In 1990, the rate of compliance with the Lead-Free Gasoline Regulations continued in a trend of improvement for the past 5 years. Only one out of the 338 samples contained lead slightly in excess of the allowable 0.013 grams per litre. The non-compliance rate was therefore 0.3 %. The rate of compliance with the Leaded Gasoline Regulations improved from 82.8% in 1989 to 100% compliance this year. The rate of nozzle switching was in the same range as the previous 3 years, at 2.2%.

RÉSUMÉ

Ce rapport décrit les programmes d'échantillonnage d'essence menés en Colombie-Britannique en 1990. Des échantillons d'essence avec et sans plomb ont été recueillis et analysés pour vérifier le contenu en plomb et vérifier la conformité avec les règlements sur l'essence avec et sans plomb.

Une étude fut aussi conduite pour examiner l'ampleur des pratiques de changement du bec verseur de pompes distribuant de l'essence avec plomb aux points de vente.

En 1990, le taux de conformité avec les règlements sur l'essence sans plomb a continué dans la direction de l'amélioration durant les 5 derniéres années. Seulement un des 338 échantillons a contenu du plomb légèrement en excès du niveau admissible de 0.013 grammes par litre. Le taux de non-conformité était de 0.3%. Le taux de conformité avec les règlements sur l'essence avec plomb a augmenté de 82.8% en 1989 à 100% conformité cette année. Le taux de changement du bec verseur était dans le même échelle que les 3 annees précédentes à 2.2%.

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SUMMARY

The Pacific and Yukon Regional office of Environmental Protection, Environment Canada monitors the lead levels in leaded and lead-free grades of gasoline in British Columbia to ensure compliance with the federal Leaded Gasoline and Lead-Free Gasoline Regulations. In 1990, 338 samples of lead-free gasoline were collected from retail outlets, bulk petroleum terminals and petroleum refineries in British Columbia. Only one of these samples contained lead in excess of the allowable lead content of 0.013 grams per litre. The compliance rate was therefore 99.7% which was in the same magnitude of 99.4% in 1988 and 100% in 1989; and has improved significantly from the 90.3% in 1979. A total of 73 samples of leaded gasoline were collected from retail outlets. The lead concentrations in all these samples were within the allowable limit of 0.29 grams per litre, resulted with a 100% compliance.

Nozzles of leaded gasoline pumps were also checked; and 2 out of 92 nozzles were undersized. The nozzle switching rate was therefore 2.2%, which was comparable with the rates of 3.2%, 4.4% and 1.4% in 1987, 1988 and 1989 respectively.

A summary of the lead-free gasoline monitoring results and nozzle switching surveys is presented in Table 1.

SUMMARY (continued)

TABLE 1 SURVEY RESULTS OF LEAD-FREE GASOLINE MONITORING AND NOZZLE SWITCHING

YEAR	TOTAL GASOLINE SAMPLES	CONTAMINA-TIONS	RATE OF CONTAMINATIONS	TOTAL SURVEYED NOZZLES	UNDER SIZED NOZZLES	NOZZLE SWITCH RATE
1974	317	7	2.2%			
1975	207	3	1.5%			
1976	284	12	4.2%			
1977	637	11	1.7%			
1978	93	6	6.5%			
1979	155	15	9.7%			
1980	251	5	2.0%	522	0	0%
1981	311	9	3.0%	434	43	10%
1982	-	-	-	-	-	-
1983	331	6	1.8%	626	457	73%
1984	398	10	2.5%	887	123	14%
1985	567	15	2.6%	1215	114	9%
1986	358	5	1.4%	781	49	6%
1987	268	2	0.8%	620	20	3.2%
1988	501	3	0.6%	893	39	4.4%
1989	303	0	0.0%	502	7	1.4%
1990	338	1	0.3%	92	2	2.2%

1 INTRODUCTION

Lead is a toxic element to human health. Fortunately, advances in industrial hygiene have virtually eliminated acute lead poisoning. But chronic exposure to lov levels of lead are known to interfere with haemoglobin synthesis and are suspected of causing neurophysiological and behavioural effects, teratogenic effects, growth inhibition and hypertension. Children are thought to be particularly susceptible to the adverse effect of lead.

In 1973, Canada emissions of lead from gasoline peaked at 14,360 tonnes accounting for approximately 70 per cent of total Canadian lead emissions to the atmosphere. In 1985, automobile lead emissions in Canada was reduced to 6000 tonnes, but still account for 61 per cent of total lead emissions in Canada. Effective January 1, 1987, the maximum allovable lead content in leaded gasoline was reduced from 0.77 grams per litre to 0.29 grams per litre. The Minister of Environment announced in 1988 the goal to effectively phase out lead in gasoline by 1993. This deadline was advancd to December 1, 1990.

In order to reduce exhaust emissions, car manufacturers have used a device called a "catalytic converter" in many post 1975 automobiles. This device cleans the exhaust gas before emitting it to the atmosphere and is capable of reducing carbon monoxide and hydrocarbon emissions by 80% to 90%. The cleaning action of the catalyst converts the harmful carbon monoxide and hydrocarbons into relatively less harmful carbon dioxide gas and harmless water vapour. Recently, a nev 3-way catalyst can, at the same time, reduce the emission of carbon monoxide and hydrocarbons as well as oxides of nitrogen. The 3-way catalyst is required to meet the nev and more stringent car exhaust emission standards that became effective in September, 1987 for 1988 model vehicles.

Catalytic converters cannot tolerate contaminants such as lead in gasoline. When burned in the combustion chamber of an engine, the lead in gasoline becomes fine particles of metallic lead or its compounds. These

fine particles form a coating over the catalyst and reduces its cleaning action by "poisoning" the catalyst. Several tank refills with leaded gasoline can poison the catalyst extensively and render the converter ineffective or useless.

Federal Regulations were promulgated in 1974 to limit the maximum lead concentration to 0.013 grams per litre in lead-free gasoline to ensure that the platinum catalyst is protected from damage. Effective December 1, 1990, the new Gasoline Regulations promulgated under the Canadian Environmental Protection Act, allow lead concentrations of 0.005 grams per litre for gasoline in general use and 0.030 grams per litre to power specified equipment such as farming machines, boats and heavy duty engines.

The car manufacturing industry together with the petroleum industry sought to avoid misfueling of cars by introducing a special fuel inlet restrictor inside the fuel filling pipe on cars that are only compatible with a small diameter nozzle on lead-free gas dispensing pumps. A car requiring lead-free gasoline has an inlet restrictor that can only receive gasoline from a nozzle size of 20.6 mm (13/16 inch) outside diameter. All pump nozzles for dispensing leaded gasoline are larger and have an outside diameter of 23.8 mm (15/16 inch) which prevents its use in any lead-free gas tank receptor.

If a small size nozzle (13/16" O.D.) is installed on a leaded gasoline pump, the retailer is providing an opportunity for dispensing leaded gasoline to a lead-free burning car, either intentionally or unintentionally. Some vehicle owners remove the inlet restrictor so that the vehicle can be deliberately misfueled. Both of these practices circumvent the intent of the emission control technology on cars and should be discouraged or prohibited.

The Pacific and Yukon Regional office of Environment Canada has been conducting surveys on the lead content in gasoline and nozzle switching practices for a number of years. During 1986-1989, an additional survey was

conducted in each year to investigate the misfueling practices by motorists. This report presents the 1990 monitoring results.

2 LEADED GASOLINE AND LEAD-FREE GASOLINE MONITORING

Samples of leaded gasoline were obtained from retail outlets in the Lower Mainland, Vancouver Island, and the Okanagan area and analyzed for lead concentration by the atomic absorption method.

The lead-free gasoline survey was also based on a spot check of retail outlets, bulk petroleum terminals, and petroleum refineries. The monitoring program was conducted in several geographical areas in B.C., typically the Greater Vancouver, Vancouver Island and Okanagan areas. Gasoline retail outlets in urban centres and gasoline storage tanks of the petroleum sector were visited without predetermination of time, location or brand. A surveyed area would not be revisited in the same year unless a serious contamination problem had been identified.

The collected samples of lead-free gasoline were analyzed the following day using a quick test colorimetric analyzer. When a high lead concentration was detected by the quick test, the sample was then analyzed again using the atomic absorption method to confirm the quick test results.

3 NOZZLE SWITCHING SURVEY

The nozzle switching survey was conducted in conjunction with the gasoline sampling program. The size of nozzles on leaded gasoline pumps was checked with a plastic template (Figure 1).

FIGURE 1 Plastic Template for Nozzle Size Measurement

The template can be used to quickly check nozzle size and identify undersized nozzles. Table 2 shows nozzle sizes that have been encountered.

TABLE 2 NOZZLE SIZE OF GASOLINE DISPENSING PUMPS

NOZZLE SIZE	OUTSIDE DIAMETER mm	OUTSIDE DIAMETER Inch	INDICATION ON TEMPLATE	IMPLICATION
Large	23.8	15/16	Does not fit into opening	Correct size to dispense leaded gasoline
Small	20.6	13/16	Fits into inner opening	One can dispense leaded gasoline easily to cars requiring unleaded gasoline
Medium	22.2	14/16	Fits into outer opening	One can dispense leaded gas to cars requiring lead-free gas by forcing the nozzle into the receptor

4 RESULTS

4.1 Leaded Gasoline Monitoring

A total of 73 leaded gasoline samples were collected from retail outlets. Sixty one samples were collected in the Lower Mainland; ten samples were collected in the Okaangan area; and two samples were collected from Vancouver Island. No sample was collected from the refineries in 1990 as all leaded gasoline samples collected from refineries in the previous 3 years did not exceed the allovable lead limit of 0.29 grams per litre. None of the 73 samples collected this year was found to exceed the allovable lead content of 0.290 grams per litre. Details of the results are tabulated in Table 3.

TABLE 3 LEADED GASOLINE MONITORING - AREAS SAMPLED

Area Sampled	Date	No. of Stations	No. of Samples	Non-compliance #	Non-compliance %
Lower Mainland					
North Vancouver	05/14	4	5	0	0
West Vancouver	05/16	4	5	0	0
Vancouver	05/18-23	10	11	0	0
Burnaby	05/25	3	3	0	0
New Westminster	05/25	1	2	0	0
Port Coquitlam	05/28	2	2	0	0
Port Moody	05/28	2	3	0	0
Richmond	06/06	2	2	0	0
Delta	06/06	2	2	0	0
Surrey	06/1,11	5	5	0	0
Langley	06/8,13	8	8	0	0
Maple Ridge	06/19	5	5	0	0
Matsqui	06/19	2	3	0	0
Abbotsford	06/19	1	1	0	0
Mission	06/28	3	3	0	0
Rosedale	06/22	1	1	0	0
Subtotal		55	61	0	0
Okanagan					
Kamloops	07/09	2	2	0	0
Savona	07/09	1	1	0	0
Cache Creek	07/10	1	1	0	0
Vernon	07/11	3	4	0	0
Penticton	07/13	1	1	0	0
Kelowna	07/13	1	1	0	0
Subtotal		9	10	0	0
Vancouver Island					
Victoria	08/10	1	1	0	0
Nanaimo	08/11	1	1	0	0
Subtotal		2	2	0	0
TOTAL		66	73	0	0

4.2 Lead-Free Gasoline Monitoring

A total of 338 lead-free gasoline samples from 14 brands were collected from 27 municipalities in the Lower Mainland, the Okanagan area and Vancouver Island. Among these 338 samples, 17 were collected from petroleum refineries, 27 were collected from bulk petroleum terminals and 294 were collected from retail outlets. Only one sample from a retail outlet in Vernon contained lead in excess of the allowable lead content of 0.013 grams per litre. Further details of the results are tabulated in Tables 4 and 5.

4.3 Nozzle Survey

A total of 92 nozzles on leaded gas pumps were measured and 2 were undersized. This yields a nozzle switching rate of 2.2% as a B.C. average; 1.5% in the Lower Mainland, 0% in Victoria and 6.7% in the Okanagan area. Nozzle switching practices have generally decreased since 1985 when the switching rates were 9.4% as the B.C. average; 4.3% in Vancouver, and 18.0% in the Okanagan area. The detailed results of the 1990 survey are presented in Tables 6 and 7.

AREA	TOTAL NOZZLES SURVEYED	NUMBER OF UNDERSIZED NOZZLES	PERCENTAGE OF UNDERSIZED NOZZLES
Greater Vancouver	68	1	1.5%
Okanagan	15	1	6.7%
Vancouver Island	9	0	0%
Total	92	2	2.2%

TABLE 4 LEAD-FREE GASOLINE MONITORING - BRANDS SAMPLED (IN BRITISH COLUMBIA)

BRAND	# OF STATIONS	# OF SAMPLES	NON-COMPLIANCES	
			#	%
ESSO	34	85	0	0.0
CHEVRON	25	53	0	0.0
SHELL	19	52	0	0.0
PETRO-CAN	31	73	0	0.0
TEXACO	1	2	0	0.0
PAYLESS	2	3	0	0.0
HUSKY	2	4	0	0.0
TURBO	2	6	0	0.0
SUPER SAVE	11	20	0	0.0
MOHAWK	6	12	1	8.3
DOMO	1	2	0	0.0
IND.	8	17	0	0.0
SAVE ON GAS	2	6	0	0.0
PAY & SAVE	2	3	0	0.0
TOTAL	146	338	0	0.3

TABLE 5 LEAD-FREE GASOLINE MONITORING - AREAS SAMPLED (IN BRITISH COLUMBIA)

AREA SAMPLED	DATE(S) SAMPLED	# OF STATIONS	# OF SAMPLES	NON-COMPLIANCES	
				#	%
LOWER MAINLAND					
NORTH VANCOUVER	May 14	8	12	0	0
WEST VANCOUVER	May 16	5	14	0	0
ABBOTSFORD	July 19	4	16	0	0
VANCOUVER	May 18-23	11	27	0	0
NEW WESTMINSTER	May 25	1	2	0	0
BURNABY	May 25	4	10	0	0
PORT COQUITLAM	May 28	2	8	0	0
PORT MOODY	MAY 28	2	4	0	0
RICHMOND	JUN 6	5	15	0	0
DELTA	JUN 6	4	14	0	0
SURREY	JUN 1,11	10	29	0	0
LANGLEY	JUN 8,13	10	26	0	0
MAPLE RIDGE	JUN 19	6	14	0	0
MATSQUI	JUL 19	5	15	0	0
MISSION	JUN 28	6	12	0	0
CHILLIWACK	JUL 22	3	9	0	0
ROSEDALE	JUL 22	1	2	0	0
SUBTOTAL		87	229	0	0
OKANAGAN					
KAMLOOPS	JUL 9	5	11	0	0
SAVONA	JUL 9	1	3	0	0
CACHE CREEK	JUL 10	5	14	0	0
VERNON	JUL 11	5	11	1	10
PENTICTON	JUL 13	5	12	0	0
KELOWNA	JUL 13	5	12	0	0
SUBTOTAL		26	63	1	1.7
VANCOUVER ISLAND					
VICTORIA	AUG 10	5	15	0	0
MILL BAY	AUG 10	1	3	0	0
DUNCAN	AUG 10	2	7	0	0
NANAIMO	AUG 11	7	21	0	0
SUBTOTAL		15	46	0	0
TOTAL		128	338	1	0.3

TABLE 6 NOZZLE SURVEY - BRITISH COLUMBIA

Total Number of Stations Surveyed : 39
Total Number of Leaded Nozzles Measured : 92
Total Number of Undersized Nozzles : 2 (2.2%)

BRAND	NO. OF STATIONS	NO. OF UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NUMBER UNDERSIZED	PERCENT UNDERSIZED
ESSO	9	1	11.1	14	1	7.9
CHEVRON	11	0	0.0	37	0	0.0
PETRO-CAN	8	0	0.0	17	0	0.0
PAYLESS	2	0	0.0	9	0	0.0
SUPER SAVE	4	1	25.0	9	1	11.1
MOHAWK	1	0	0.0	1	0	0.0
INDEPENDENT	3	0	0.0	4	0	0.0
PAY & SAVE	1	0	0.0	4	0	0.0
TOTAL	39	2	5.1	92	2	2.2

6 DISCUSSION

Since January 1987 when the amended Leaded Gasoline Regulations became effective, there were no violations reported by the leaded gasoline production plants in B.C. However, our 1989 survey found that among 29 samples of leaded gasoline collected from retail outlets in Vancouver and the Fraser Valley, 5 samples contained lead in excess of the allovable limit of 0.29 grams per litre. In 1990, a more extensive sampling program was conducted to investigate the status of compliance. A total of 73 spot samples from the Lover Mainland, Vancouver Island and the Okanagan area were collected and analyzed. We found that none of these samples contained lead in excess of 0.290 grams per liter, with one hundred per cent compliance. This is an improvement to the 17.2 % non-compliance rate in 1989.

The rate of lead-free gasoline contamination continued in a trend of improvement since 1985. In 1990, one of the 338 samples contained lead exceeding 0.013 grams per litre. As the nev Gasoline Regulations became effective December 1, 1990, gasoline production and import for general use would not exceed 0.005 grams of lead per litre. There will be no leaded gasoline in the normal distribution system and hence the main source of lead contamination will be removed. It is anticipated that lead contamination of lead-free gasoline will not occur under normal circumstances.

In 1990, an effort was made to monitor the status of lead contamination at bulk petroleum terminals. A total of 27 lead-free samples were taken from 7 bulk terminals in the Lover Mainland and the Fraser Valley. None of the samples contained lead exceeding the allovable 0.013 grams per litre.

The nozzle switching practice as a provincial average, maintained at 2.2% as compared to 1.4% in 1989, 7.3% in 1988, and 3.2% in 1987. As there will have no leaded gasoline in the distribution system after

December 1, 1990, the nozzle switching practice will have no impact On the contamination of lead-free gasoline.

As a result of public awareness and government action to reduce lead in gasoline, the demand and supply of lead-free gasoline has increased steadily in B.C., from a mere 5.2% of total gas production in 1975, to 58.6% in 1988 and 95.5% in 1990, as indicated in Figure 2. Also, the increased use of lead-free gasoline by the general public has resulted with improvement in air quality. By using lead measurement data from 5 air monitoring stations in Vancouver, which have been operating since 1975, the lead in ambient air has been reduced to 13% of the 1975 level, from a 0.8 ug/m (micrograms per cubic meters) in 1975 to the 1989 level of 0.11 ug/m^3 as indicated in Figure 3.

Figure 2 LEAD IN GASOLINE

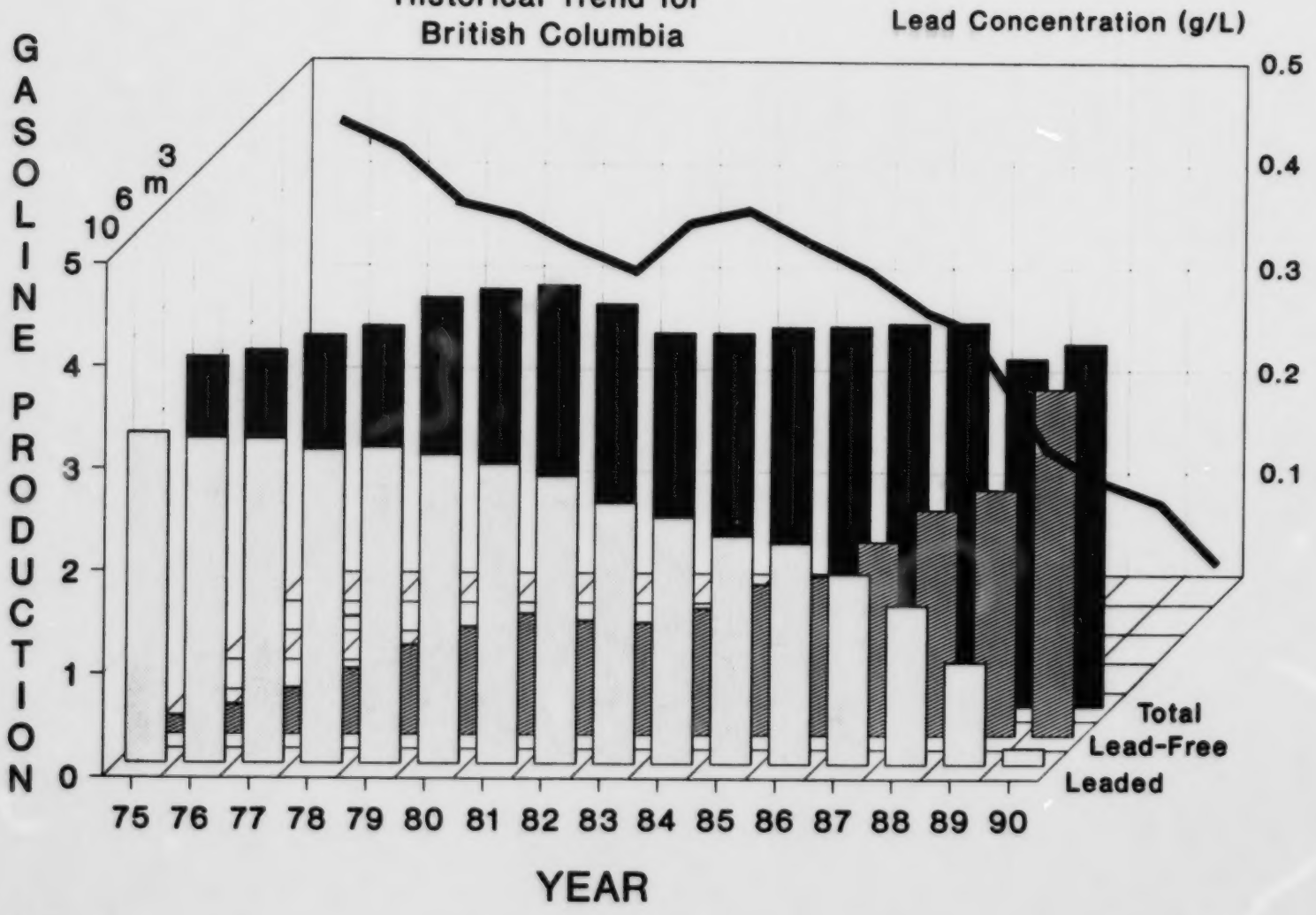
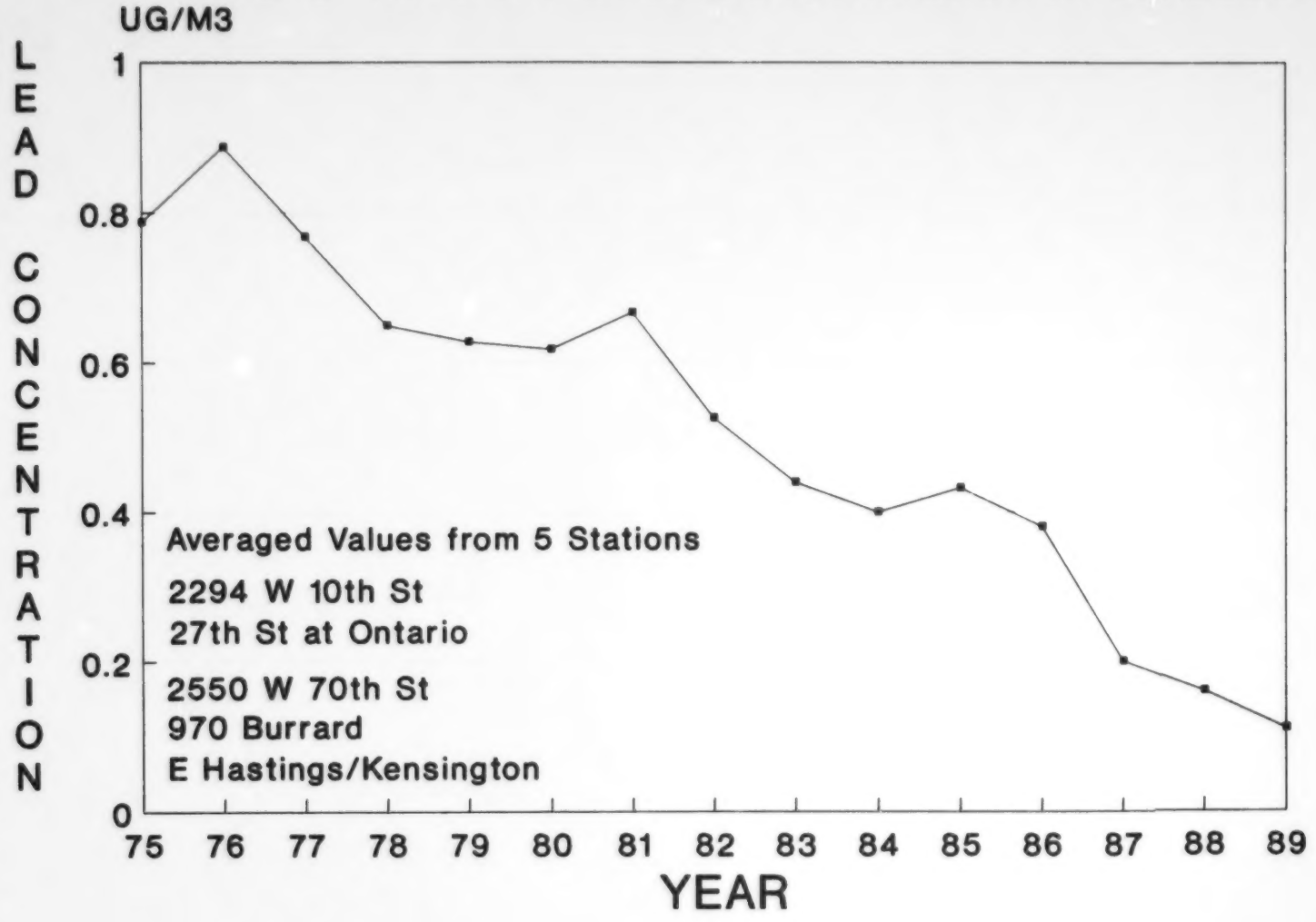


FIG 3 Ambient Lead Concentration in Vancouver



APPENDIX I

HISTORICAL DATA ON
LEAD-FREE GASOLINE CONTAMINATION

APPENDIX I

TABLE 1 NUMBER OF CONTAMINATED SAMPLES (1974-1990)

YEAR	NUMBER OF CONTAMINATIONS IDENTIFIED IN EPS (PACIFIC & YUKON REGION) MONITORING PROGRAM									TOTAL NO. OF SAMPLES
	C	B	D	A	E	H	F	G	OTHERS	
1974	1	1	2	2	1	0	0	0	0	317
1975	-	-	-	-	-	-	-	-	3	207
1976	0	2	1	2	3	0	0	1	3	284
1977	0	1	2	5	1	0	1	0	1	637
1978	0	0	1	3	2	0	0	0	0	93
1979	1	2	2	1	5	0	2	2	0	155
1980	1	3	2	2	0	0	1	0	0	273
1981	7	3	2	7	1	1	1	-	2	350
1982	-	-	-	-	-	-	-	-	-	---
1983	1	1	0	3	1	0	0	0	0	331
1984	0	3	2	0	0	1	1	1	2	398
1985	2	2	3	2	0	1	1	2	2	567
1986	0	0	2	0	1	0	2	0	0	358
1987	0	0	-	1	0	0	0	0	1	268
1988	0	1	-	0	2	0	0	0	0	501
1989	0	0	-	0	0	0	0	0	0	303
1990	0	0	-	0	0	0	0	1	0	338
TOTAL	13	19	19	28	17	3	9	7	14	5077/129

A = CHEVRON

B = SHELL

C = ESSO

H = HUSKY

E = PETRO CAN (Formerly PACIFIC and GULF)

F = TEXACO

G = MOHAWK

D = GULF (some stations retained the Gulf sign until 1987)

APPENDIX I

TABLE 2 LIST OF CONTAMINATED LEAD-FREE GASOLINE (1974-1981)

YEAR	LEAD CONCENTRATIONS (g/IG) IN THE IDENTIFIED CONTAMINATIONS								
	C	B	D	A	E	H	F	G	OTHERS
1974	0.950	0.230	0.123 0.076	0.064 0.068	0.072	- -	- -	- -	- -
1975	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.190 0.180 0.080
1976	-	0.110 0.070	0.090	0.090 0.070	0.090 0.070 0.150	-	-	2.000	0.420 0.320 0.080
1977	-	0.127	0.180 0.230	0.090 0.080 0.190 0.080 1.000	0.123	-	-	-	-
1978	-	-	0.062	0.163 0.079 0.149	0.089 0.064	-	-	-	-
1979	0.086	0.244 0.244	0.065 0.244	0.082 0.068	0.076 0.263 0.147 0.101 0.168	-	0.063 0.147	0.282 0.263	-
* 1980	0.074 -	0.071 0.063 0.078	0.942	0.068 0.065 0.188	-	-	0.090	-	-
* 1981	0.220 0.076 0.093 0.082 0.063 0.063 0.069	0.070 0.200 0.200	0.130 0.100	0.200 0.085 0.088 0.096 0.072 0.062 0.074	0.065	0.150	0.150		0.200 0.104

* Data of Whitehorse Branch included

APPENDIX I

TABLE 3 LIST OF CONTAMINATED LEAD-FREE GASOLINE (1982-1989)

YEAR	LEAD CONCENTRATIONS (g/L) IN THE IDENTIFIED CONTAMINATIONS								
	C	B	D	A	E	H	F	G	OTHERS
1982	-	-	-	-	-	-	-	-	-
1983	0.0172	0.0172	0	0.066 0.0273 0.048	0.026	0	0	0	0
1984	0	0.044 0.030 0.016	0.030 0.017	0	0	0.017	0.037	0.037	0.040 0.021
1985	0.018 0.030	0.040 0.028	0.015 0.015 0.031	0.028 0.021	0	0.042	0.023	0.018 0.030	0.014 0.015
1986	0	0	0.077 0.020	0	0.016	0	0.100 0.023	0	0
1987	0	0	-	0.021	0	0	0	0	0.014
1988	0	0.025	-	0	0.019 0.018	0	0	0	0
1989	0	0	-	0	0	0	0	0	0
1990	0	0	-	0	0	0	0	1	0